instruction manual

326A

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INSTRUCTION MANUAL

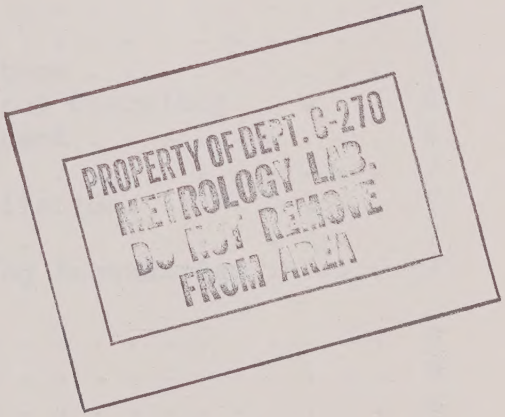
FOR

OXYGEN ANALYZER

MODEL 326A

SERIAL NUMBER

18174



TELEDYNE ANALYTICAL INSTRUMENTS
333 WEST MISSION DRIVE
SAN GABRIEL, CALIFORNIA 91776

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1. INTRODUCTION

The Teledyne Analytical Instruments (TAI) Model 326 line of analyzers utilizes a unique Micro-fuel Cell to measure the concentration of oxygen in a gas stream. The analysis is specific for oxygen; i.e., the measuring cell will not generate an output current unless oxygen is present in the sample gas. Therefore, the instrument has an absolute zero, and no zero gas is required to standardize the analyzer.

The measuring cell has the ability of accurately responding to the presence of oxygen irrespective of flowrate. The analyzer can be calibrated using atmospheric air as a span gas, providing one of the three ranges of analysis encompasses the oxygen content of air.

The measuring cell (U.S. Patent No. 3,429,796) is a "solid-state", maintenance free structure, whose performance and usable life are guaranteed by TAI. Oxygen is consumed by the cell from the gas around it, and a proportionate micro-ampere current generated. The low level signal is then amplified by a solid-state, integrated circuit (IC) amplifier, and the resulting D.C. signal is suitable for driving a high impedance recording device (such as a self-balancing potentiometer), a temperature compensation circuit for the cell, and an integral 0-100 micro-ampere meter. The output signal is linear over the specified ranges of analysis.

The analyzer is housed in a compact sheet steel equipment case. Considerable consideration was given to keeping the overall profile of the instrument as small as possible to conserve the customer's panel space. The electrical and sample flow controls are located on a swing down panel behind the door of the instrument. All interior plumbing interconnections are made with Imperial Eastman Poly-flow tubing so that the front panel may be opened without disturbing the sample system.

1.1 Standard Features. The following features are standard in the Series 326A line of analyzers. Instruments equipped with only these features are identifiable by the basic number of the series, i.e., Model 326A.

1.1.1 Three Ranges of Analysis. The standard ranges of analysis are 0-5, 0-10, and 0-25% oxygen. Range

control is achieved through the positioning of a control panel mounted selector switch. The standard ranges have been selected to best cover the oxygen content of flue gas. Upon request, any three ranges of analysis from 0-1 to 0-100% can be provided.

1.1.2 Integral Meter Readout. All models of the Series 326A are equipped with an accurate 3 inch panel meter for direct readout of the analysis. A linear scale promotes reliable, accurate readout of the analysis at any point on the scale. The resolution and accuracy of the instrument's meter obviates the necessity of an accessory readout device--unless permanent recording or remote indication is required.

1.1.3 Output Signal. For those applications requiring a remote indication and/or recording of the sample oxygen, a linear output signal of from 0-1 millivolt to 0-1 volt D.C. is available at no extra charge. The desired magnitude of signal should be specified at the time of purchase. Unless otherwise specified, the output signal will be 0-1 volt D.C.

The output signal is not suitable for driving low impedance devices. Accessory equipment must have an input impedance of 10,000 ohms or more.

1.1.4 Temperature Control and Compensation. To eliminate the inaccuracies caused by varying temperature conditions that are inherent in most methods of analysis employing transducers, a system composed of a combination of temperature compensation and control is used in the Series 326A.

To protect the Micro-fuel Cell against damage from low ambient temperatures and reduce the range required of the compensation circuit, the analyzer is equipped with a thermostatically controlled radiant heating system that will not permit the interior of the instrument to drop below 70°F.

To eliminate the inaccuracies accompanying the positive temperature coefficient of the Micro-fuel Cell, a specially selected thermistor and network of precision resistors is utilized to produce a negative coefficient of matching characteristics. The variable element (thermistor) in the compensation network is physically located in the same assembly as the Micro-fuel Cell so that both devices are exposed to essentially the same temperature conditions.

By employing compensation techniques to compensate high temperature conditions (up to 125°F), the customer may disturb the integrity of the analyzer by opening the door without the equalibration time that would normally accompany systems employing only high temperature control. In addition, the life of the Micro-fuel Cell is extended by not subjecting it to the high ambient temperature that would be required in an exclusively temperature controlled system.

1.1.5 Modular Electronics. The amplifier features the latest in integrated circuit (IC) semi-conductor components. The electronic components are mounted on a plug-in printed circuit board--as are the various optional (see Section 1.2) electronic features. Although circuit failure is unlikely, plug-in capability of the critical elements of the circuit facilitates instant solution in the event of a semi-conductor failure--providing the customer backs up his instrument with a recommended spare. The faulty circuit board may then be returned to the factory for repairs. The economy of having an available spare part in contrast to requiring the services of a highly trained service man should be apparent. The printed circuit assemblies are pre-set and adjusted that they may be instantly interchanged.

1.2 Optional Features. The following optional features are available at extra cost, and are offered by TAI to make the Series 326A as nearly independent of accessory equipment as possible.

1.2.1 Integral Alarm Circuitry. One (Model 326A-1) or two (Model 326A-2) adjustable (full scale) alarm and/or control circuits are available.

Control over an external circuit is achieved by a relay whose coil is operated by an electronic comparator circuit. The switch contacts of the relay (N.C.-C-N.O.) are available for interconnection with customer circuitry at the terminal strip within the analyzer. The control point at which the relay operates is determined by the setting of a calibrated dial equipped potentiometer on the control panel. The linearity of the oxygen signal and 10 turn "set point" potentiometer, plus the resolution (500 discrete divisions) of the turns counting dial, provides precise alarm or control capability at any oxygen concentration within the range capability of the analyzer.

The integral control circuitry can be arranged so that the relay is energized above or below the set point. Unless otherwise specified, the control relay in a single set point instrument (Model 326A-1) will be energized downscale from the set position, and the relays in a double set point instrument (Model 326A-2) will be energized when the oxygen level is reading in the scale region between set point #1 (on the lower region of the scale) and set point #2 (on the upper portion of the scale). These configurations provide power supply failure (as well as oxygen alarm) information--as the relays are arranged to be in an energized condition when the oxygen concentration of the sample is in the safe region of the scale.

The form "C", SPDT relay contacts are rated at 5 amperes (non-inductive).

1.2.2 E to I Converter. TAI also offers a voltage (E) to current (I) conversion of the output signal generated by the Series 326A amplifier circuit, so that I (current) to P (pneumatic devices, as well as low impedance current operated indicating and/or recording equipment, may be driven directly without the need of accessory equipment.

Three (3) ranges of current output are available:

1) 1 to 5 milliamperes D.C.
2) 4 to 20 milliamperes D.C.
3) 10 to 50 milliamperes D.C.

The designation Model 326A-I signifies an analyzer equipped with an E to I converter.

1.2.3 Optional Feature Packaging. Both the integral alarm and E to I converter options are plug-in printed circuit boards for quick replaceability. When either or both of the options are employed in an instrument, a highly regulated differential power supply (also a plug-in printed circuit board) is included to supply the positive and negative voltage required by the semi-conductor circuitry. The basic Model 326A employs a simple unregulated power supply. (The rectifying diodes and filtering capacitors are located on the same board as the detection and amplifier circuitry); however, the alarm comparator and converter circuits require that the supply voltage remain at a constant level to all circuitry in the interest of accuracy. When options are employed, the unregulated

power supply components are deleted from the amplifier board, and the amplifier, as well as the option circuit, is fed from the regulated differential power supply.

2. INSTALLATION

2.1 Location. The analyzer should be installed in an area that is sheltered from the elements. The instrument case is not to be considered water tight by the customer. In areas where the ambient temperature is expected to drop below 0°F, auxillary heating must be provided.

An outline diagram showing the location and identification of the gas line and electrical conduit connections, as well as the physical dimensions of the analyzer, is included among the drawings at the rear of the manual.

TAI suggests that the mounting holes be line drilled, using the analyzer itself as a templet, after the panel cutout has been made.

2.2 Electrical Connections.

2.2.1 Power. A source of single phase, 50 or 60 cycle, 110 to 120 volt power, capable of delivering 2 amperes of current continuously, is required to operate the analyzer.

Power connections are made inside the cover at the back of the analyzer. Refer to the electrical interconnection diagram at the rear of the manual, and polarize the connections as indicated. Connect an equipment ground wire to the terminal identified "G" on the drawing.

2.2.2 Output Signal Voltage. All models of the Series 326A are equipped to provide an output signal voltage. The magnitude of the signal, which is determined at the time of purchase, can be preset by TAI to any value from between one (1) volt and one (1) millivolt. Unless otherwise specified, the output will be 0-1 volt D.C. Refer to the "Specification Data" section of the manual to determine the output signal magnitude.

The output signal, regardless of magnitude, is suitable for high impedance devices only (10,000 ohms minimum).

Two (2) conductor, 22 gauge (AWG), shielded cable is recommended for interconnection purposes. Polarize the signal connections as shown on the interconnection diagram and connect the shield to the analyzer only.

2.2.3 Alarm and/or Control Circuitry. Models having a -1 or -2 as part of their model number are equipped with single (-1) or double (-2) alarm and/or control circuits (see Section 1.2.1 for descriptive information).

The SPDT form "C" contacts (normally closed-common-normally open) of the relay (or relays) are available on the terminal strip within the analyzer. To properly use the switch that the relay contacts represent, the customer must determine when the relay (or relays) is energized (above or below set point). When applicable, this information is documented in the "Application Section" of the manual. The appropriate terminal strip connections are identified on the interconnection diagram.

For those not familiar with relay terminology, the terms normally open (N.O.) and normally closed (N.C.) refer to the relay contact configuration when the relay is in a de-energized condition.

The load current per relay must be limited to five (5) amperes (non-inductive).

2.2.4 Output Signal Current. Instruments which include the designation "I" as part of their model number are equipped with an E to I converter to provide a DC milliampere output signal as well as a DC voltage output signal.

Three (3) ranges of current output are available. They are:

1) 1 to 5 MA DC; suitable for devices with from 0 to 6,000 ohms impedance (resistive).

2) 4 to 20 MA DC; suitable for devices with from 0 to 1,500 ohms impedance (resistive).

3) 10 to 50 MA DC; suitable for devices with from 0 to 600 ohms impedance (resistive).

The appropriate terminal strip connections are identified on the interconnection diagram, and the applicable output

current range will be found documented in the "Application Section" of the manual.

2.3 Gas Connections. The sample input, vent and purge connections are 1/8 inch female N.P.T., and are located on the underside of the analyzer case. Both are identified on the outline diagram. TAI suggests that Teflon sealing tape be used as a sealant rather than pipe dope. Use care in ascertaining that mating fittings are not cross-threaded before applying force with a wrench. The gas connector block in the analyzer is aluminum (for most applications), and will undoubtedly be damaged by abuse before the mating fitting is.

2.3.1 Sample Line Installation. Unless span gas is specified, the analyzer requires only a pressure reducing regulator installed at the sample point, and the necessary interconnecting tubing. The regulator should be set between 5 and 50 psig. - 10 psig is nominal.

If the ranges of the analyzer do not encompass the oxygen content of air, span gas will be required to calibrate the instrument. The cylinder span gas will have to be manifolded with the sample gas externally. TAI can furnish gas selector panels, in a variety of configurations, to suit the customer's needs.

2.3.2 Vent Connection. Wherever possible, TAI recommends that the analyzer be allowed to vent directly to the atmosphere. If venting directly is not possible, the following conditions must be met in vent line installation:

1) The vent line must be constructed of 1/4 inch tubing (or the equivalent), so that no appreciable back pressure resulting from restricted flow is experienced by the analyzer.

2) The vent line must terminate in an area that experiences no more than normal barometric pressure changes.

3) The vent line must be installed so that water and dirt cannot accumulate in it.

2.3.3 Sample Conditioning Accessories. The sample must be free of entrained solids and water. A high humidity sample gas; however, is ideal--as it will prevent water loss from the cells electrolyte.

3. STARTUP

3.1 Preliminary. Before supplying power to the instrument, TAI suggests that the electrical wiring installation be checked against the interconnection diagram--particularly if the installation has been made by personnel other than those responsible for startup and operation.

All accessory hardware and fittings between the analyzer and sample point should be leak tested under pressure prior to startup.

In many instances, proper attention to these two preliminaries will prevent severe damage (accidental wiring transpositions) and ambiguous analysis (diffusion leaks in the sampling system).

3.2 Meter Zero. Before turning the power to the analyzer on (range switch in any position but "OFF"), the mechanical zero of the meter should be checked and adjusted (if necessary). The meter indicating pointer should be in precise coincidence with the scale zero mark. Adjust the screw on the face of the meter to zero the pointer. This step is important if full advantage of the accuracy of the meter is to be realized, and even more important if remote indicating and/or recording equipment is involved in the system. An offset zero on the meter will result in a tracking error between the two devices, which would be significant if the meter is used to calibrate the analyzer (normal procedure). IMPORTANT: NEVER ATTEMPT TO MAKE THIS ADJUSTMENT WITH THE POWER ON.

3.3 Measuring Cell Installation. The Micro-fuel Cell is supplied separately in a controlled atmosphere package, and must be installed prior to startup. It is particularly important with Class A-3 cells that the cell be left in its sealed bag until immediately before the instrument is to be started up and a source of CO_2 containing gas is available (refer to Paragraph 5.2, Page 12). To install the cell, use the following procedure:

1) Make sure the range switch is in the "OFF" position (power off).

2) Open meter panel by turning Dzus fastener in the middle of the top edge of the panel 1/2 turn counter clockwise, pull panel down on its bottom hinge.

3) Locate the cell holder assembly (gray plastic cylinder with electrical cable coming out of its end).

withdraw the cell probe from holder (use twisting motion); remove the cap by unscrewing (ccw).

4) Open the cell package and remove the shorting clip.

5) Place the Micro-fuel Cell in the probe with the sensing surface facing towards the outside and the printed circuit contact end facing the contacts inside the probe body. Replace cap previously removed (refer to instructions furnished in cell box).

6) Insert the cell probe back into the probe holder by pushing and a slight twist until it strikes bottom.

3.4 Initial Calibration and Equalibration. Before stable, reliable operation can be guaranteed, the Micro-fuel Cell will require a period of time to adjust itself to its new environment. To the casual observer monitoring the integral meter, this period of time will appear to be about 15 minutes. In actuality, true stability is not achieved for many hours, which can be demonstrated by recording the output on a circular chart recorder, and analyzing the results of the first 24 hours of operation. The user will note a few percentage points of drift covering a period of hours after the initial first 15 minutes of equalibration.

If speed is of the essence, TAI suggests that the instrument be placed in service after it appears to have stabilized (usually about 15 minutes), and the slight instability of the ensuing hours tolerated. Any error incurred during this period will be eliminated during the first operational calibration.

If, on the other hand, reliable analysis, free of instrument distortion, is required from the very onset of operation, TAI recommends a 24 hour run-in period before operational calibration and service.

In either case, employ the following procedure:

1) Turn the analyzer range switch to the 0-25% position. Power has now been established to the instrument.

2) Connect analyzer input to a supply of calibration (span) air.

3) Adjust the throttle valve so that an indicated flow-rate of 2.0 scfh is registered on the flowmeter. Wait about three to five minutes (allow reading to stabilize) before proceeding to next step.

NOTE: Instrument may be calibrated by withdrawing cell probe from its holder, thus exposing the cell to the surrounding atmosphere.

4) Unlock and adjust the span control until the meter pointer is in coincidence with the "CALIB." mark (black mark on the red 0-25% scale, at 20.9%) on the meter scale. Relock the span control.

NOTE: If recorder or remote indicator is used for primary readout, calibrate to 83.9% of full scale on recorder or indicator for maximum accuracy.

5) Connect analyzer input to the sample gas and retrim the throttle valve for an indicated flow-rate of 2.0 scfh, (or insert probe holder back into its holder).

NOTE: Analyzer accuracy is not affected by variations in sample flow rate. The recommended flow rate of 2.0 scfh insures maximum speed or response.

6) Select the range of analysis that will provide the best possible resolution of the oxygen content of the sample gas.

7) Allow sample gas, not calibration air, to flow through the analyzer. IMPORTANT: IT IS PARTICULARLY VITAL TO THE CONDITION OF THE A-3 CELL EMPLOYED IN FLUE GAS (OR HIGH CO_2 CONTENT APPLICATIONS) THAT THE CELL NOT BE EXPOSED TO A CO_2 FREE ENVIRONMENT FOR A PROLONGED PERIOD OF TIME.

3.5 Operational Calibration. After the equalibration period following the installation of any new cell, or whenever it is desirable to recheck the calibration of the instrument, employ the following calibration procedure:

1) Place the range selector switch on the 0-25% position.

2) Connect the analyzer input to a supply of calibration (span) air and adjust the flowrate to 2.0 scfh.

3) Unlock and adjust the span control until the meter pointer is in precise coincidence with the scale calibration mark and relock the span control.

4) Return the instrument to service by restoring sample flow at the proper rate (2.0 scfh), and selecting the range that provides the best possible resolution of the sample oxygen.

3.5.1 Calibration of Alarm Equipped Instruments. To prevent generating ambiguous alarms during calibration, simply unlock and rotate the set point dial (or dials) until the limits of travel in the "NORMAL" (rather than "ALARM") direction have been attained. After sample flow has been reinitiated, and the proper scale of analysis selected, the alarm point can be precisely reset by simply re-dialing the set point.

3.5.2 Calibration of Converter Equipped Instruments. The current output of the converter always tracks the output of the measuring circuit amplifier. No provisions for interlocking the converter to a particular range of analysis have been provided. If the current output is being used to operate a pneumatic control device, the customer will be required to provide the necessary electrical or mechanical interlocks.

4. ROUTINE OPERATION

4.1 Sample Flow. The sample flow should be checked daily to guard against stoppage resulting from particulate matter.

4.2 Calibration. Span calibration should be checked every two to four weeks.

5. MAINTENANCE

5.1 Routine Maintenance. No moving parts other than the meter movement and the relay contacts of -1 and -2 models are contained in the Series 326A analyzer; therefore, periodic

service is not required. The sample flow check and infrequent calibration outlined in Section 4 should be adequate to keep the analyzer functioning throughout the life span of a given Micro-fuel Cell.

5.2 Special Shut-Down Precaution for Class A-3 Cell. When the analyzer is equipped with a Class A-3 cell, it must be protected from prolonged exposure (more than 4 hours) to CO_2 free atmospheres (such as air). This can be accomplished by trapping CO_2 containing sample (flue gas) by closing the input manifold valves and sealing the vent connection with a valve, water trap or clamped-off plastic tubing.

5.3 Cell Replacement. When the Micro-fuel Cell nears the end of its useful life, sensitivity will decline very rapidly. The initial response to this phenomenon will be to recalibrate the analyzer. If many turns of span control are required to recalibrate the instrument, or if in fact, as most often will be the case, the control does not have sufficient range to recalibrate the analyzer, a new Micro-fuel Cell will be required.

To offset the possibility of not having a replacement cell available when it is needed, TAI recommends that a spare cell be ordered shortly after the instrument is placed in service, and each time the cell is replaced thereafter. CAUTION: DO NOT OVER ORDER (OR STOCKPILE) SPARE CELLS. Only one cell per instrument should be in reserve.

5.4 Cell Warranty. The Micro-fuel Cell carries a warranty that covers its normal life expectancy. Three types (or classes) of cell are employed in the Series 326A. Each class carries its own warranty, and selection of the class cell employed is a function of the customer's application. The various classes of cell, the guidelines governing their use, and the applicable warrantees covering each class are outlined in the following sub-sections.

5.4.1 Class A-3 Cell. The Class A-3 cell must be used for any application where the carbon dioxide content of the sample gas is in the region of from one (1) to twenty (20) percent.

The A-3 cell is warranted for 40,000 percent-hours (approximately twelve months of service in a 5% oxygen concentration at a temperature of 75°F) or six months, whichever occurs first.

5.4.2 Class C-3 Cell. The Class C-3 cell is employed in CO_2 free applications where a response time of 90% in 30 seconds can be tolerated in the interest of long cell life.

The C-3 cell is warranted for 240,000 percent-hours (approximately 18 months of service in air at 75°F (or 1 year, whichever occurs first.)

5.4.3 Class B-1 Cell. Class B-1 cells are employed in CO_2 free applications where fast response (90% in 10 seconds) is of paramount concern.

The Class B-1 cell is warranted for 80,000 percent-hours (approximately 6 months of service in air at 75°F) or 6 months, whichever occurs first.

5.4.4 Warranty Conditions. Customers having warranty claims must return the cell in question to the factory for evaluation. If it is determined that failure is due to faulty material or workmanship, the cell will be replaced free of charge (CAUTION: Evidence of tampering or abuse will render the warranty null and void). If a cell was working satisfactorily, but fails short of its warranty period, the customer will receive credit, on a pro-rated basis, towards the purchase of a replacement cell.

5.4.5 CO_2 Effect on C-3 and B-1 Cells. A graph showing the effects of different concentrations of CO_2 on the C-3 and B-1 cells is on the following page.

6. TECHNICAL INFORMATION

6.1 Transduction and Temperature Compensation. The TAI 326 Series Oxygen Analyzers utilize a unique electrochemical transducer whose features include:

1) Specificity for oxygen.
2) Maintenance free operation.
3) Long calibration interval and life.
4) Disposable configuration.
5) Low cost.

The transducer functions as a fuel cell; in this instance, the fuel is oxygen. Oxygen diffusing into the cell reacts chemically to produce an electrical current that is proportional to the oxygen concentration in the gas phase immediately adjacent to the cells sensing surface.

Since the cell has a positive temperature coefficient, this variable must be eliminated. The useful life of the cell is limited by the total amount of current produced throughout its life. Taking these two facts into consideration, together with a design goal of providing maximum accuracy, a combination of temperature compensation and temperature control has been utilized. Temperature compensation using thermistor circuits has been used from 30 to 125°F. This compensation alone will result in an accuracy specification of plus or minus 5% of full scale. By adding temperature control starting at 25°C (77°F) and optimizing the thermistor compensation in the interval between 70 and 125°F, accuracy has been increased to plus or minus 1%. Even greater accuracy could be achieved by using only temperature control and controlling at 125°F; but, the cell life would be reduced by 50% or more. Therefore, by temperature compensation and temperature control, TAI has achieved reasonable accuracy consistent with long maintenance-free operation.

6.2 Integral Cell Protection. An N-channel field effect transistor (FET) is incorporated in the circuitry across the cell to short circuit the cell whenever the power to the instrument is off. The FET switches to a very high resistance instantly when power is supplied to the analyzer, and is essentially no longer part of the circuit.

The FET is necessary because of the characteristics of the cell and the operational amplifier. When in operation, the amplifier input circuit looks like a short to the cell (approximately one ohm). If the power were interrupted, without some means of short circuiting the cell, the amplifier would appear as an open circuit to the cell. Since the cell is a current generating device, these two circuit extremes (short circuit-open circuit) would necessitate a prolonged period of equilibration. With the incorporation of the FET in the cell circuit, the cell looks into essentially a short circuit at all times and the instrument responds immediately when power is restored to the circuit.

7. APPLICATION DATA

7.1 TAI SALES ORDER NUMBER: 86838

7.2 INSTRUMENT MODEL NUMBER: 326A

7.3 INSTRUMENT SERIAL NUMBER: 18174

7.4 MICRO-FUEL CELL CLASS: A-3

7.5 ACCURACY: ± 1% of scale at constant temperature; ± 1% of scale or ± 5% of reading, whichever is greater, over the operating temperature range.

7.6 RESPONSE AND RECOVERY: At the specified flowrate (2.0 scfh), 90% in 60 seconds.

7.7 OPERATING TEMPERATURE RANGE: 0-125°F.

7.8 RANGES OF ANALYSIS: 0-5, 0-10, 0-25 %

7.9 OUTPUT SIGNAL VOLTAGE: 0-1 VDC

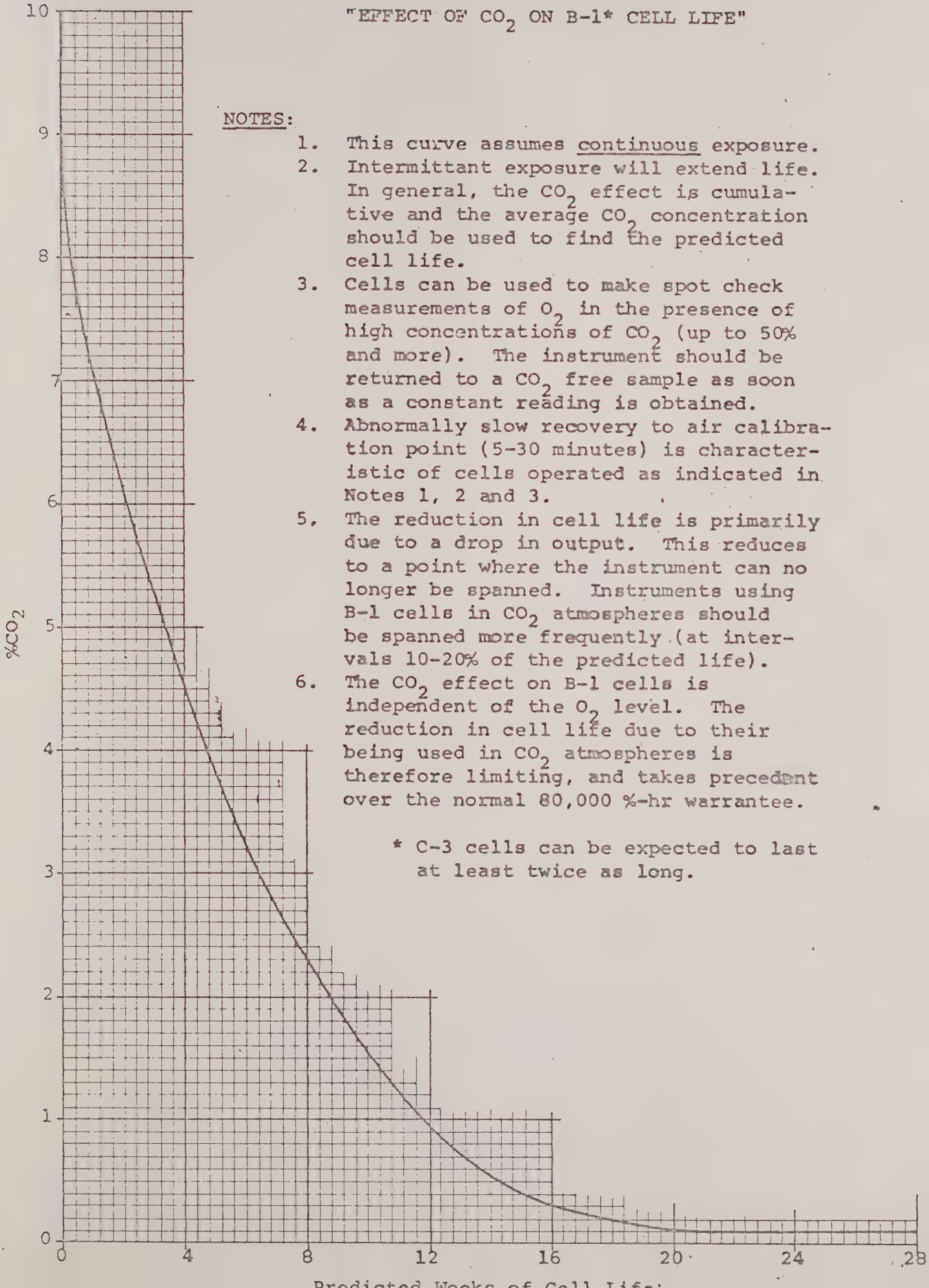
7.10 OUTPUT SIGNAL CURRENT: N/A

7.11 ALARM SET POINT #1: N/A

7.12 ALARM SET POINT #2: N/A

8. SPECIAL FEATURES:

"EFFECT OF CO_2 ON B-1* CELL LIFE"



NOTES:

1. This curve assumes <u>continuous</u> exposure.
2. Intermittant exposure will extend life. In general, the CO_2 effect is cumulative and the average CO_2 concentration should be used to find the predicted cell life.
3. Cells can be used to make spot check measurements of O_2 in the presence of high concentrations of CO_2 (up to 50% and more). The instrument should be returned to a CO_2 free sample as soon as a constant reading is obtained.
4. Abnormally slow recovery to air calibration point (5-30 minutes) is characteristic of cells operated as indicated in Notes 1, 2 and 3.
5. The reduction in cell life is primarily due to a drop in output. This reduces to a point where the instrument can no longer be spanned. Instruments using B-1 cells in CO_2 atmospheres should be spanned more frequently (at intervals 10-20% of the predicted life).
6. The CO_2 effect on B-1 cells is independent of the O_2 level. The reduction in cell life due to their being used in CO_2 atmospheres is therefore limiting, and takes precedent over the normal 80,000 %-hr warrantee.

* C-3 cells can be expected to last at least twice as long.

TAI SERIES 326A

RECOMMENDED SPARE PARTS LIST

QUANTITY	PART NO.	DESCRIPTION	UNIT PRICE *
1	A-9348	Amplifier Printed Circuit Board	$ 143.75
1	S-81	Triac, G.E., SC45B	13.00
1	T-176	Thermoswitch, 70°F	21.05
1	H-28	Heater, 125W	27.00
5	F-10	Fuse, Littlefuse, Type 3AG, 2 Amp.	.95
** 1	C-6689	Cell Assembly	
		Class B-1, Color Code Tan	50.00
		Class A-3, Color Code Black	75.00
		Class C-3, Color Code Red	100.00

* Prices subject to change without notice.

** Orders for TAI cell assemblies must include the class of the cell specified in Section 7 of the instruction manual, and the serial number of the analyzer in which the cell is to be used.

IMPORTANT: Orders for replacement parts should include the above part number, and the model and serial number of the analyzer for which the parts are intended.

A minimum charge of $15.00 applies to spare parts orders.

Orders should be sent to:

TELEDYNE ANALYTICAL INSTRUMENTS
333 West Mission Drive
San Gabriel, California 91776

Rev. 3-1-77

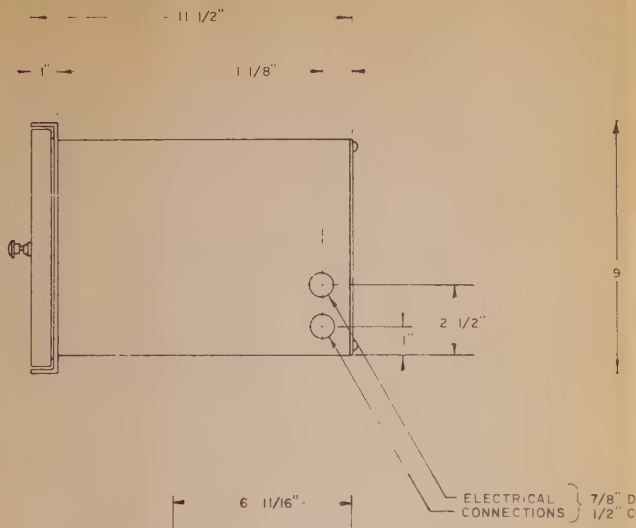
NEW

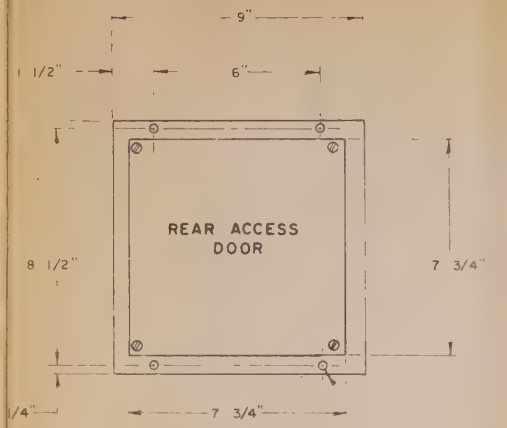
DRAWING LIST

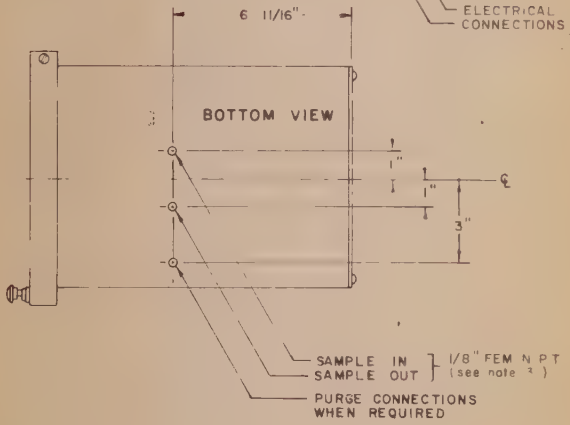
MDL. 326A

B-7052	ANALYZER OUTLINE DIAGRAM
A-7095	INTERCONNECTION DIAGRAM
A-10578	PIPING DIAGRAM
B-10576	SCHEMATIC
C-10951	WIRING DIAGRAM
C-10941	P. C. BOARD ASSY. & WIRING

ISSUE NO.	APP.
REDR	
3 5-18-67	
REV. MDL. NO. 4. 9-17-71	







NOTES

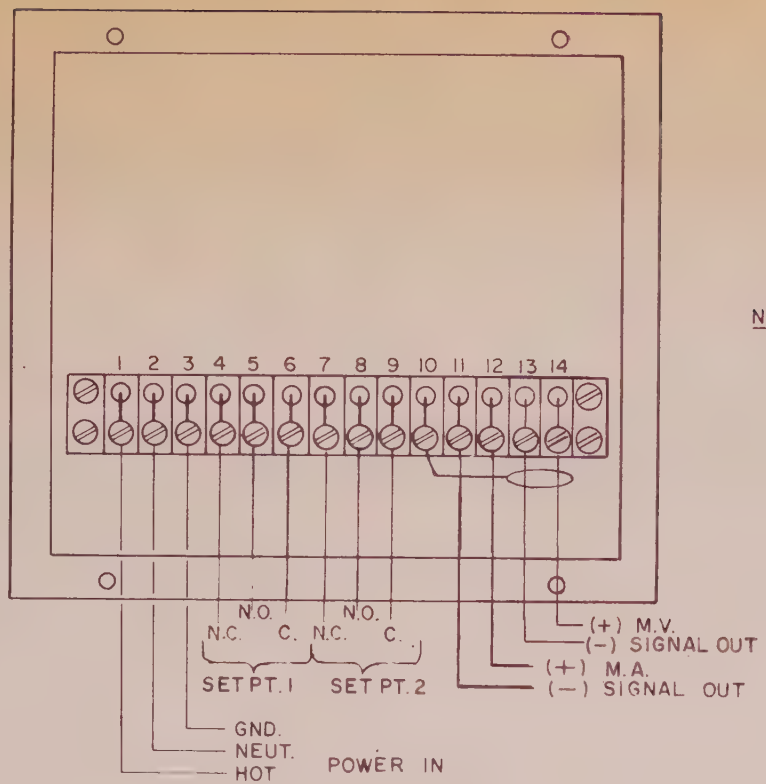
1. CUTOUT FOR PANEL MOUNTING 7 7/8" X 7 7/8"
2. USE CASE TO LINE DRILL MOUNTING HOLES IN PANEL
3. INSTALL GAS LINE FITTINGS WITH TEFLON TAPE AS SEALER

CAUTION MAKE SURE FITTINGS ARE NOT CROSS THREADED BEFORE USING WRENCH

TOLERANCE UNLESS OTHERWISE SPECIFIED	FRACT. ± 1/64	DEC. ± .003	ANGULAR ± 1/2°
TELEDYNE ANALYTICAL INSTRUMENTS A DIVISION OF TELEDYNE INC. PASADENA, CALIFORNIA		SCALE	5-10 DATE 67
		MATL:	
		FINISH.	
OXYGEN ANALYZER SER. 326 A OUTLINE DIAGRAM		DR S / ENGR / APP	
		DWG No. B-7052	

PASADENA BLUEPRINT CO. PRINTED ON 1000H-8 CLEARPRINT

ISSUE NO.	APP.
REV. 8 REDR.	
5. 10-5-72	



NOTES:

1. GROUND SHIELD OF SIGNAL CABLE AT ANALYZER ONLY AS SHOWN.
   DO NOT GROUND EITHER OUTPUT SIGNAL LEADS.

   POWER AND SIGNAL LEADS SHOULD BE PLACED IN SEPARATE CONDUITS.

2. WIRE RECOMMENDATIONS:

   - SIGNAL -

   Nº 22 GA. SHIELDED CABLE

   - POWER AND GROUND -

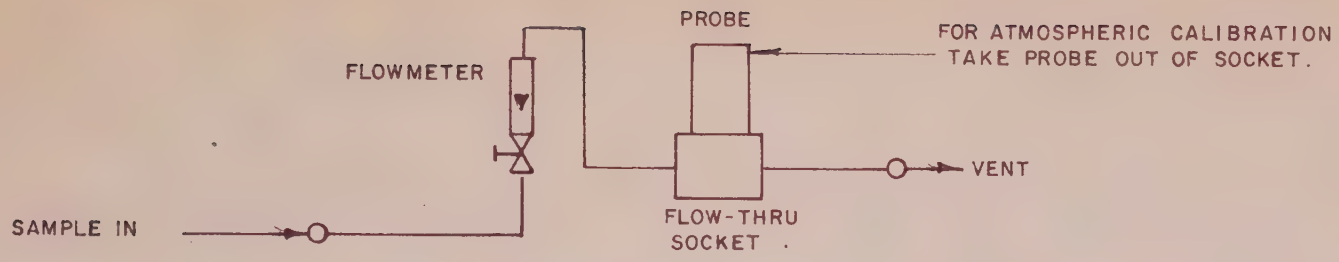
   Nº 16 GA.

   ALARM CIRCUIT

   Nº 16 GA

TOLERANCE UNLESS OTHERWISE SPECIFIED	FRACT. ± 1/64	DEC. ± .003	ANGULAR ± 1/2°
TELEDYNE ANALYTICAL INSTRUMENTS A DIVISION OF TELEDYNE INC PASADENA, CALIFORNIA		SCALE	DATE 5-19-67
		MATL:	
OXYGEN ANALYZER SER.326A INTERCONNECTION DIAGRAM		FINISH:	
		DR S	ENGR APP
		DWG No. A—7095	

ISSUE NO.	APP.
1. 9-21-71	g



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TOLERANCE UNLESS OTHERWISE SPECIFIED	FRACT. ± 1/64	DEC. ± .005	ANGULAR ± 1/2°

ANALYTICAL INSTRUMENTS
A TELEDYNE COMPANY
SAN GABRIEL, CALIFORNIA

SCALE —— DATE 9-21-71

MATL:

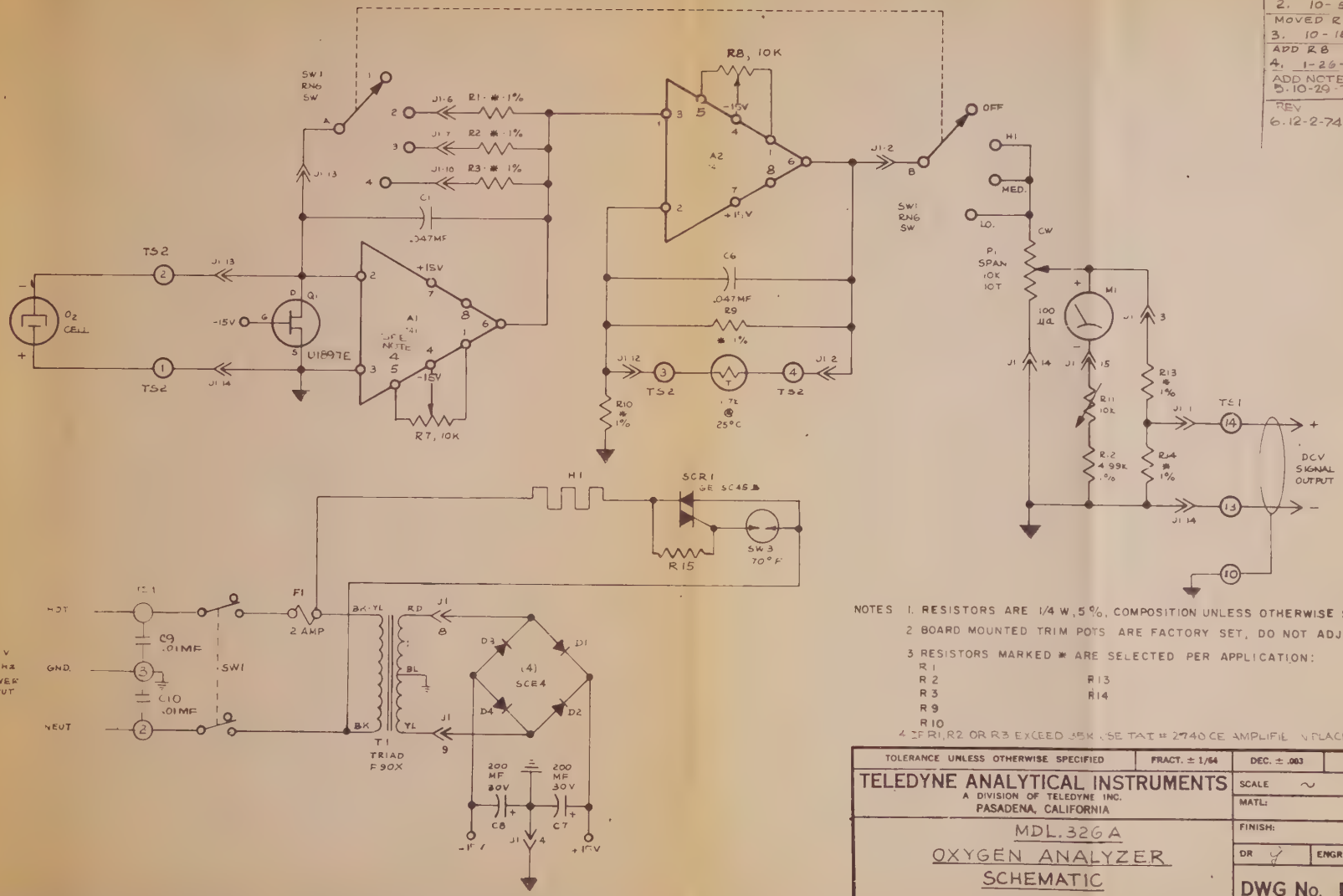
FINISH:

SER. 326 A
OXYGEN ANALYZER
PIPING DIAGRAM

DR G	ENGR	APP

A-10578

ISSUE NO.	APP.
1, 9-21-71	
REV. TS1, TS2 2. 10-5-72	
MOVED R7 3. 10-18-72	
ADD R8 4. 1-26-73	
ADD NOTE 4 5. 10-29-74	
REV 6. 12-2-74	



NOTES 1. RESISTORS ARE 1/4 W, 5%, COMPOSITION UNLESS OTHERWISE SPECIFIED.

2 BOARD MOUNTED TRIM POTS ARE FACTORY SET, DO NOT ADJUST

3 RESISTORS MARKED * ARE SELECTED PER APPLICATION:

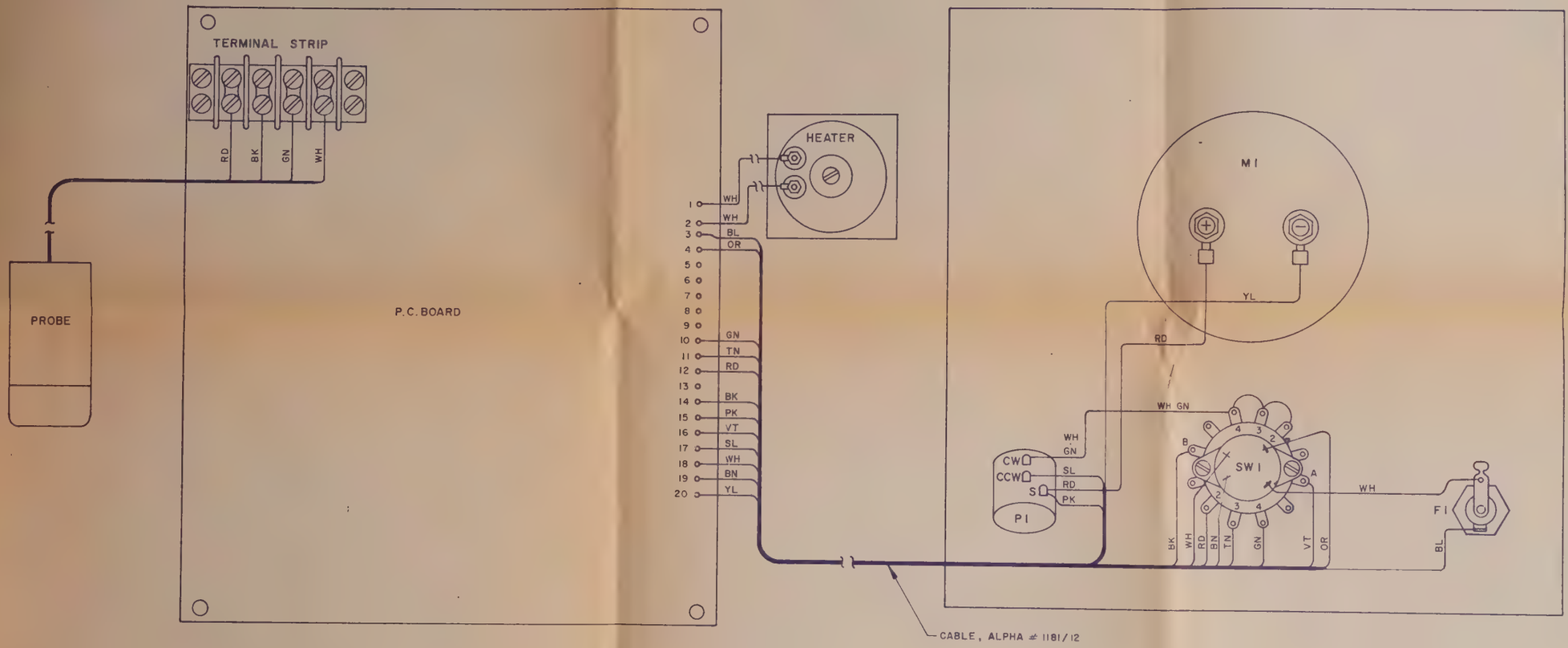
R1	
R2	R13
R3	R14
R9	
R10	

4 IF R1, R2 OR R3 EXCEED 35K USE TAI # 2740 CE AMPLIFIER PLACE OF TAI AC A.

TOLERANCE UNLESS OTHERWISE SPECIFIED	FRACT. ± 1/64	DEC. ± .003	ANGULAR ± 1/2°
TELEDYNE ANALYTICAL INSTRUMENTS A DIVISION OF TELEDYNE INC. PASADENA, CALIFORNIA		SCALE ~	9-21-71
		MATL: ~	
MDL. 326A OXYGEN ANALYZER SCHEMATIC		FINISH: ~	
		DR	ENGR MR APP
		DWG No. B-10576	

PASADENA BLUEPRINT CO PRINTED ON 1000H-8 CLEARPRINT

ISSUE NO.	APP.
REV & REDRAWN 2. 4-27-73	9



NOTE: OVER ALL CABLE LENGTH : 28".
SLEEVE BETWEEN FRONT PANEL
& P.C. BOARD : 9 1/2"
CUT OFF UNUSED WIRES:
COVER POWER TERMINALS ON SW1 & F1
WITH SHRINK TUBING ---

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TOLERANCE UNLESS OTHERWISE SPECIFIED | FRACT. ± 1/64 | DEC ± .005 | ANGULAR ± 1/2°

ANALYTICAL INSTRUMENTS
A TELEDYNE COMPANY
SAN GABRIEL, CALIFORNIA

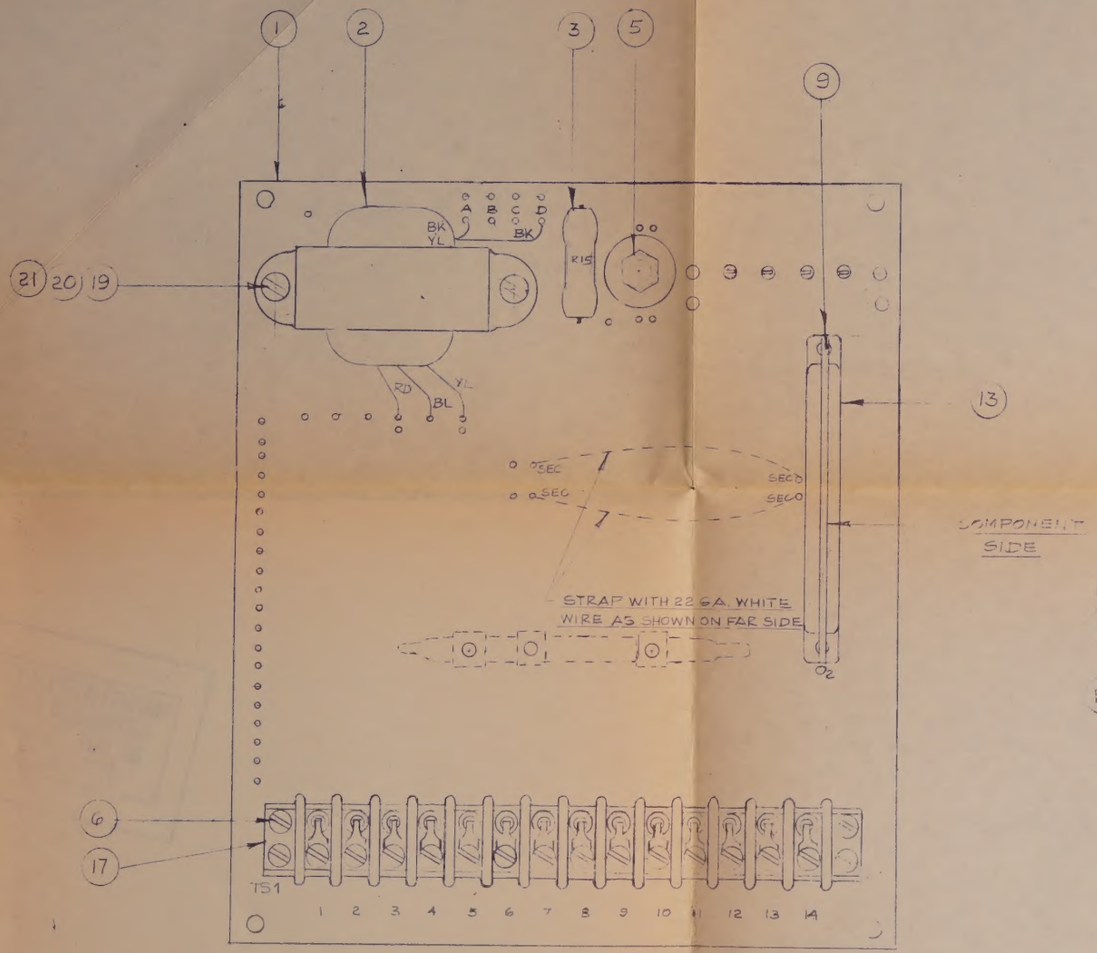
SCALE —— DATE 4-27-73
MATL:
FINISH:

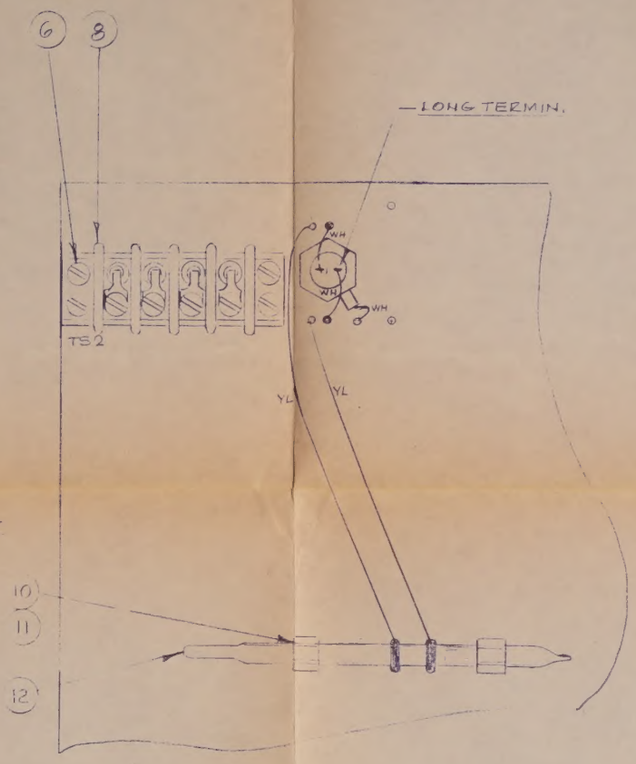
OXYGEN ANALYZER MODEL 326A
WIRING DIAGRAM

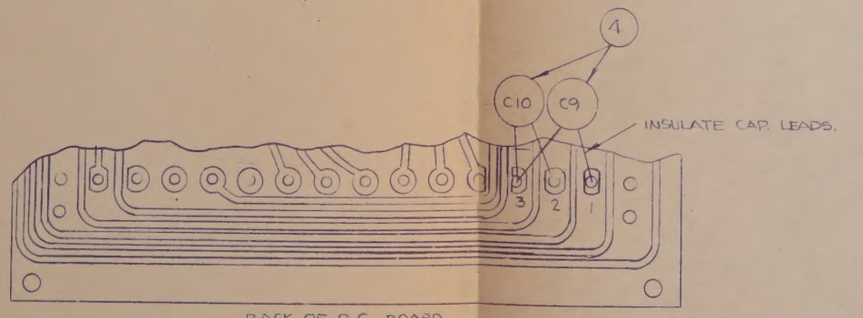
DR G.S. | ENGR | APP

C-10951

ISSUE NO.	APP.
1. 7-12-72	9
2. 9-15-72	9
ADD CAP. C9, C10 3-12-5-74	9







BACK OF P.C. BOARD

ITEM	PART NO.	REQ.	DESCRIPTION
21		2	NUT, 6-32 HEX.
20		2	LOCKWASHER #6
19		2	SCREW, 6-32 x 3/8", BIND. HD.
18			
17	T19	1	TERMINAL STRIP, 14-140Y
16			
15			
14			
13	C257	1	CONNECTOR
12	T176	1	THERMO SWITCH
11	F12	2	FUSE CLIP
10		2	SCREW, 4-40 x 1/4" FIL. HD.
9	A-9348	1	P.C. BOARD ASS'Y. O_2-AMPLIF.
8	T53	1	TERMINAL STRIP, 4-140-Y
7			
6		8	SCREW, 6-32 x 1/2" BIND. HD.
5	S81	1	TRIAC
4	C340	2	CAPICATOR .01MF 1KVDV
3	R201	1	RESISTOR, 5K, 5W
2	T107	1	TRANSFORMER
1	B-10929	1	P.C. BOARD

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TOLERANCE UNLESS OTHERWISE SPECIFIED | FRACT. ± 1/64 | DEC. ± .005 | ANGULAR ± 1/2°

ANALYTICAL INSTRUMENTS
A TELEDYNE COMPANY
SAN GABRIEL, CALIFORNIA

SCALE FULL | DATE 7-12-72

MATL: NOTED

FINISH:

OXYGEN ANALYZER
MDL. 326 A
P.C. BOARD ASS'Y. & WIRING

DR 9 | ENGR | APP

C-10941

PROPERTY OF DEPT. C-270
METROLOGY LAB
DO NOT REMOVE
FROM AREA